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National Mobility and Career Performance of the Scientific Workforce in Colombia

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Abstract

Academic mobility plays a crucial role in fostering intellectual collaboration, knowledge transfer, and the internationalization of science. While existing research has extensively examined international scientific migration, national mobility, particularly in middle and low-income countries, remains underexplored. This study investigates the relationship between national mobility and career performance within Colombia's scientific workforce, using unique data from national assessments conducted between 2013 and 2021. The analysis includes 12,084 researchers, with career trajectories evaluated using ordered probit regression models. Here, we show that mobility, defined as moving across municipalities, is not significantly associated with changes in researchers' career rankings. Instead, structural and individual factors, such as prior rank, institutional affiliations, and years of experience, emerge as the main drivers of career progression. Additionally, residing in large cities appears to negatively affect rankings, possibly due to intensified competition for resources and funding. These findings highlight the importance of cumulative advantage mechanisms and institutional dynamics over geographic mobility in shaping scientific careers. Future research should expand on this framework by incorporating institutional prestige and cross-country comparisons to better understand the nuanced interplay between mobility and academic performance.

Introduction

Academic mobility is a key factor in science policy, promoting intellectual collaboration, innovative knowledge production and transfer, and the internationalization of national science systems (Cavalli & Teichler, 2015; Gureyev et al., 2020; Momeni et al., 2022; Morano-Foadi, 2005; Soete et al., 2021; Sugimoto et al., 2017). It has also become a prominent subject in quantitative science studies, where the most relevant topics include the development of methodological approaches, the flows of scientific migration, the impact of scientific mobility, factors driving scientific mobility, and historical perspectives (Gureyev et al., 2020). Despite this, most research has been directed toward international migration, highlighting the lack of understanding of the dynamics of national scientific workforce mobility in middle and low-income countries (Liu et al., 2024).

Migration and mobility, though related, differ primarily in their permanence. According to Teichler (2015), migration signifies a permanent relocation, such as a scientist moving from the country of citizenship to another to take up a permanent research position. In contrasts, mobility refers to non-permanent or repeated movements without a permanent change in residence, such as a scientist participating in an international research exchange for a few months (Teichler, 2015).

Concerning exceptional studies on national mobility, evidence from the United States shows that professors are more likely to move to institutions with higher research intensity and from rural to urban areas, with female professors more frequently relocating within the same geographic region than their male counterparts (Yan et al., 2020). At Washington State University, researchers showed high mobility rates, with domestic movers demonstrating greater citation impacts than international movers (Payumo et al., 2018). In Italy, the centralized and non-competitive university system results in lower post-mobility performance, particularly for less productive researchers (Abramo et al., 2022). Faculty in Turkish public universities, especially women, older individuals, and those in major cities or well-established institutions, are less likely to move nationally (Yuret, 2023). Tuning the attention into Latin America, the signing of NAFTA increased the flow of inventors in México to multinational companies, exacerbating the brain drain, while regional disparities in mobility persist, with Mexico City as a key destination (Aboites & Díaz, 2018). Over time, migration intensity has decreased, but the diversity and density of migration networks across Mexican states has increased (Miranda-González et al., 2020).

In this context, this research aims to test the following hypothesis for the Colombian scientific workforce:

H_0: Researchers' mobility is not associated with career performance (i.e., changes as progressions or declines in their national assessment ranking).

H_a: Researchers' mobility is associated with career performance.

We choose Colombia as a Latin American country with notable characteristics such as a science system with negligible financial resources but noticeable efficiency in scientific output and a history of intense forced internal displacement caused by an armed conflict since the 1960s (Cortés & Ramírez Cajiao, 2024; SCImago, 2020; UNHCR, 2023). In pursuing this goal, we aim to contribute to the emerging literature on national academic mobility by examining the relationship between mobility and academic career dynamics, leveraging open-access data from government agencies rather than relying solely on traditional bibliographic sources like WoS or Scopus.

Methodology

Data

We used open-access datasets curated and issued by the Colombia's Ministry of Science, Technology, and Innovation (MinCiencias). These datasets provide information from national assessments conducted in 2013, 2014, 2015, 2017, 2019, and 2021. Our analysis sources the socioeconomic data and academic career data on Colombian researchers (MinCiencias, 2023).

Colombian researchers are assessed as units within the national evaluation system, categorized into *Junior, Associate, Senior,* or *Emeritus* ranks based on criteria like academic output, leadership, and mentoring. Researchers are responsible for updating their portfolios on the national platform (CvLAC), detailing their disciplinary expertise and research outputs, with oversight from institutional and research group leadership. However, rank progression does not influence salary or career advancement within their employing institutions (Vasen et al., 2023).

We sub-sampled the data to the cohorts of researchers assessed in 2013, 2014, and 2015 which enables at least a 5-year window —a standard time window in research evaluations (Wang, 2013)— to examine the dynamics of mobility and career advancement. We excluded researchers who migrated to another country at least once during any national assessment, as our focus is solely on domestic mobility. However, researchers born abroad but currently residing in Colombia were included in the sample. This sub-sample comprises 12,084 researchers.

Methods and variables

In this exploratory stage of the project, we implemented an *ordered probit regression* to analyze the association between researcher mobility patterns and their career performance. The dependent variable is the last ranking observed for each researcher. Besides mobility-related variables, we also included additional demographic, institutional, and geographic variables into the model as independent and control variables.

Demographic variables.

- Gender: a proxy to assess potential disparities or biases in rankings and career progression based on gender.
- Age: a proxy for capturing career stage, maturity, or productivity levels, which can influence ranking changes.

Mobility and geographic factors.

- Mobile researcher (*moved*): the municipality of residence differs from the municipality of birth (1 = yes, 0 = no).
- Number of cities (*n_cities*): number of different cities of residency of the researchers between 2013-2021. A proxy for a researcher's frequent mobility patterns/intensity (i.e., adaptability or flexibility) (1 city=~95% of researchers; 2 cities=~4%; 3 cities=~1%)
- Living in a big city *(pop_gt1M):* Dummy variable indicating whether the researcher resided in a city with more than 1 million inhabitants in 2020 (1 = yes, 0 = no). Large cities typically offer better research infrastructure, networking opportunities, and resources.

Ranking and institutional characteristics.

- Ranking first (*ranking_first*): the first rank at which the researcher was assigned in the national assessment.

- Ranking changes: number of changes in the researchers rank in the sample. Zero (0) would be those who never changed rank. A proxy for a researcher's (in)stability in their career progression or decline.
- Number of institutional affiliations (*institution_id_n*): corresponds to the number of different institutions to which the researcher is attached. A proxy for tracking a researcher's changes in research environments and diversity of potential academic collaboration.

Academic career.

- Career performance *(progress_career): c*orresponds to the number of changes —positive: progression(s), negative: decline(s)— in the researcher's career. A proxy for measuring the career trajectory/dynamic based on changes in their national rank.
- Career upward *(progress_carreer_dummy): d*ummy variable that corresponds only to progressions in the researcher's career, useful for identifying drivers of career advancement and enabling a separate evaluation of progression versus stagnation or decline.
- Experience: defined as the years since the researcher first participated in the calls (2021 - [year of the first call]). A proxy that reflects cumulative experience and academic visibility.

Supplementary material 1 reports the descriptive statistics of the variables.

Results

The Table 1 reports the results, of which we will focus on the *Ranking Last III* model which shows the highest explanatory power and used a wider range of independent variables. This model's McFadden's pseudo R-squared indicates that ~10% of the variation in researchers' career rankings is explained by the included variables. The results largely support the null hypothesis (H_0), which posits that researchers' mobility is not associated with career performance. The variable `moved` shows no significant relationship across all models, indicating that moving institutions does not predict changes in ranking. Similarly, the significance of `n_cities` in the first model diminishes when additional controls are included, suggesting its limited explanatory power. Instead, the analysis highlights the importance of structural and individual characteristics—such as `ranking_first`, `experience`, and `institution_id_n`—as primary drivers of career performance. Additionally, contextual effects, captured by regional variables like `pop_gt1M`, play a significant role, further diminishing the role of mobility in explaining changes in researchers' rankings.

Table 1. Ordered probit regression results.

Variable	Ranking Last I	Ranking Last II	Ranking Last III
gender	0.1494***	0.1457***	0.1442***
	(0.0222)	(0.0222)	(0.0222)
age	-0.0040***	-0.0025**	-0.0022**

		(0.0011)	(0.0011)	(0.0011)
n_cities		0.0988**	0.0096	0.0070
		(0.0469)	(0.0478)	(0.0478)
ranking_first		0.8483***	0.8567***	0.8598***
		(0.0188)	(0.0188)	(0.0188)
moved		0.0023	-0.0041	-0.0164
		(0.0218)	(0.0218)	(0.0221)
experience		0.2332***	0.2277***	0.2291***
		(0.0147)	(0.0147)	(0.0147)
	1/2	2.8554***	3.0297***	3.0084***
		(0.1232)	(0.1246)	(0.1247)
	2/3	-0.2095***	-0.2038***	-0.2028***
		(0.0160)	(0.0160)	(0.0160)
	3/4	0.4433***	0.4480***	0.4485***
		(0.0192)	(0.0192)	(0.0192)
institution_id_n			0.1703***	0.1731***
			(0.0166)	(0.0166)
pop_gt1M				-0.0821***
				(0.0216)
Log-likelihood ratio chi-squared		2662.16	2767.18	2781.69
Log-likelihood ratio p-value		0.0000	0.0000	0.0000
McFadden pseudo R squared		0.0992	0.1032	0.1037
Obs		12084	12084	12084

Note: p<.1, ** p<.05, ***p<.01

Discussion and conclusions

This study aimed to contribute to the emerging literature on national academic mobility by examining the relationship between mobility and academic career dynamics. The results align with the null hypothesis (H_0), suggesting no significant association between researchers' mobility and career performance. Frequent changes in residency, even at the national level, might create a perception of geographic instability, which could influence upward career performance efforts. Instead, the cumulative advantage and path dependency—captured by variables such as ranking_first and institution_id_n—provide a stronger explanation for the latest career rankings, particularly among seasoned researchers with extensive experience (Merton, 1988; Price, 1976). Furthermore, the inclusion of contextual variables, such as pop_gt1M and its negative effect, likely reflects the heightened competition for funding and talent in large municipalities and cities, which often serve as key hubs for attracting researchers (Verginer & Riccaboni, 2021). Our study is limited to a single national case and does not account for further institutional factors (e.g., directional mobility towards reputable national institutions), or regional/national variables (e.g., socio-economic factors acting as push/pull drivers for mobility). Future stages of the project will incorporate some of these variables and expand the

analysis to include comparative cases, potentially, from other developed/developing countries. Also, it will incorporate additional variables and expand the analysis to include comparative cases from other developed and developing countries while also exploring alternative indicators of mobility, such as institutional changes within the same city or research collaborations across institutions to capture a more nuanced understanding of mobility's impact on career performance, and disentangling the mechanisms underlying the negative impact of large cities, including competition, resource distribution, and policy-making priorities.

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Supplementary material

Supplementary material 1 Descriptive statistics

	Total	Moved	Not Moved
N	12,084	6,604 (54.7%)	5,480 (45.3%)
Variable	Total	Moved	Not Moved
gender (= male)	7,668 (63.5%)	4,314 (65.3%)	3,354 (61.2%) ***
Age	46.073 (10.306)	46.310 (10.587)	45.787 (9.949) *
experience	7.392 (0.772)	7.395 (0.775)	7.388 (0.768)
n_cities	1.052 (0.232)	1.095 (0.307)	1.000 (0.000) ***
ranking_changes	0.791 (0.919)	0.793 (0.927)	0.787 (0.909)
ranking_first	1.334 (0.582)	1.330 (0.582)	1.339 (0.582)
ranking_last	1.756 (0.868)	1.758 (0.872)	1.753 (0.864)
institution_id_n	1.354 (0.643)	1.390 (0.680)	1.309 (0.593) ***
moved (= 1)	6,604 (54.7%)	6,604 (100.0%)	0 (0.0%) ***

') Kruskal-Wallis test, ") Fisher exact test, "") Chi-Square test. Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1. Standard deviation in parenthesis

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